Cruise Report
U.S. Geological Survey Research Cruise 2018-660-FA
Santa Barbara Littoral Cell, California
September 24-28, 2018

Dan Hoover, Patrick Barnard
USGS

Summary

From September 24 - 28, 2018, the Pacific Coastal and Marine Science Center of the U.S Geological Survey (USGS) conducted single-beam bathymetric surveys in the nearshore waters of the Santa Barbara Littoral Cell (Figure 1). The work was conducted using two Coastal Profiling Systems (CPS) (personal watercraft outfitted with custom GPS and echosounder survey equipment). Watercraft were launched out of Santa Barbara and Ventura Harbors. The survey was the twentieth in a series of surveys in this area, starting in October 2005.

The shoreline of the Santa Barbara Littoral cell consists of a diverse assemblage of sandy, rocky and armored segments with a variety of exposures to waves and currents due to differing degrees of sheltering by offshore islands and nearshore reefs. There are numerous small streams and creeks and two major river systems (Ventura and Santa Clara) that provide highly variable inputs of terrestrial sediment into the littoral cell. The Santa Clara River is noteworthy as it is the largest source of sediment to southern California nearshore waters. Alongshore transport is driven by wave activity and primarily is from NW to SE, with nearshore sediments ultimately feeding into the Mugu submarine canyon at the southern end of the littoral cell. There is significant development along much of the coastline. Surveys in this region are designed to document coastal evolution on a variety of timescales, from short-lived but intense large surf and flood events to seasonal and decadal changes, to improve our understanding of the coastal processes that affect shoreline erosion and accretion. Data from these surveys are being used in models of coastal change, including future conditions that include sea level rise and climate change, and to support management of existing coastal resources.

The September 2018 survey covered the same areas surveyed in Spring 2018, including the new Montecito focus area and other lines added in Spring 2018. The expanded survey coverage was retained to document possible impacts from the January 9, 2018 Montecito mudflows and flood discharges from area streams, and from flood sediment reuse on Goleta Beach.

It was determined that the operating frequency of the sonar system (200 kHz) is above the cutoff hearing threshold for marine mammals, therefore the CSLC determined that the observance of a safety zone is not a requirement for this survey (personal communications, K. Keen, CSLC), and that a marine wildlife monitor (MWO) was not required due to operational limitations of the personal watercraft used.

USGS research cruise 2018-660-FA took place over 5 consecutive days from September 24-28, 2018. The Carpinteria focus area and the northernmost Rincon-area lines were surveyed

on 9/24. The Ventura focus area, minus a few of the northernmost lines, was surveyed on 9/25, with the remaining Ventura and Rincon lines surveyed on 9/26. The Goleta area was surveyed on 9/27, and the Montecito area on 9/28. All operations, including transits and surveying, took place during daylight hours (0830 – 1430). Mapping was completed using hull-mounted 200-kHz , Odom 9 degree downward conical beam transducers and Odom Echotrac CV100 echo sounders at survey speeds of ~4 knots. Weather observations are provided in Appendix A and marine wildlife observations in Appendix B. As-surveyed track lines are shown in Figures 2-6, with start and end coordinates listed in Tables 1-10.

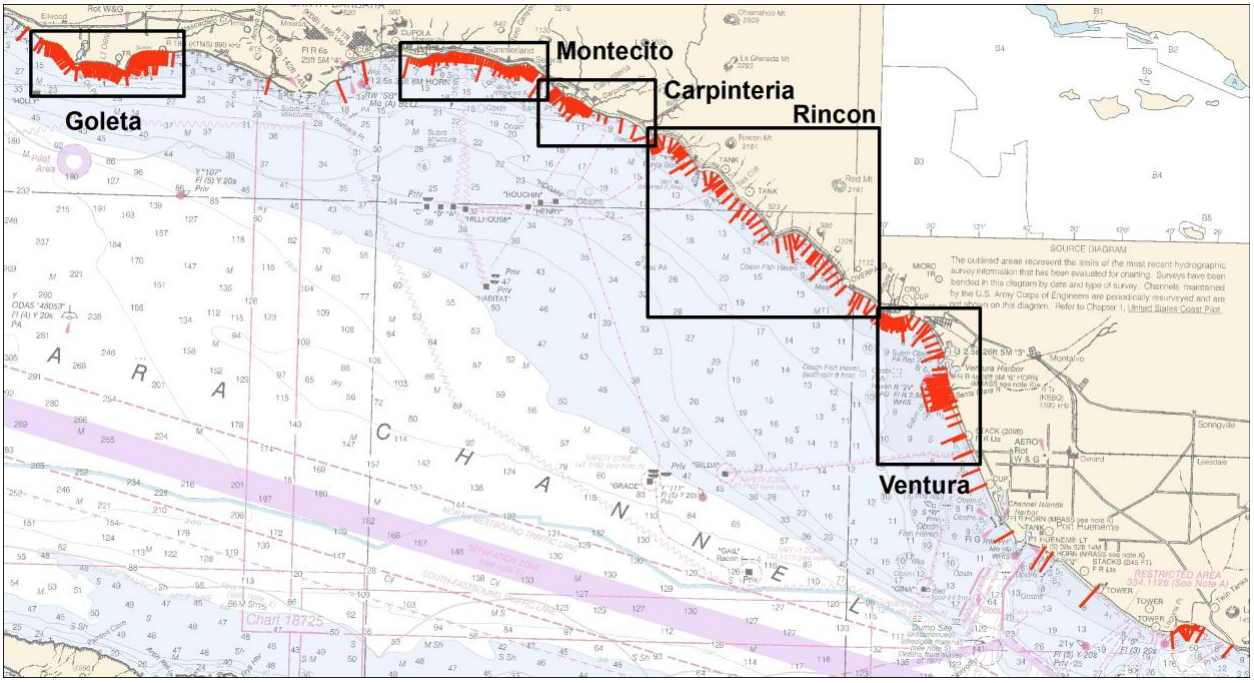

Figure 1. Overview of Santa Barbara Littoral Cell study area and planned Fall 2018 survey lines in five focus areas. Longer lines in and between focus areas are BEACON lines, which are surveyed in the Fall in odd years. Lines south of the Ventura focus area are BEACON and Mugu focus area lines that were not surveyed.

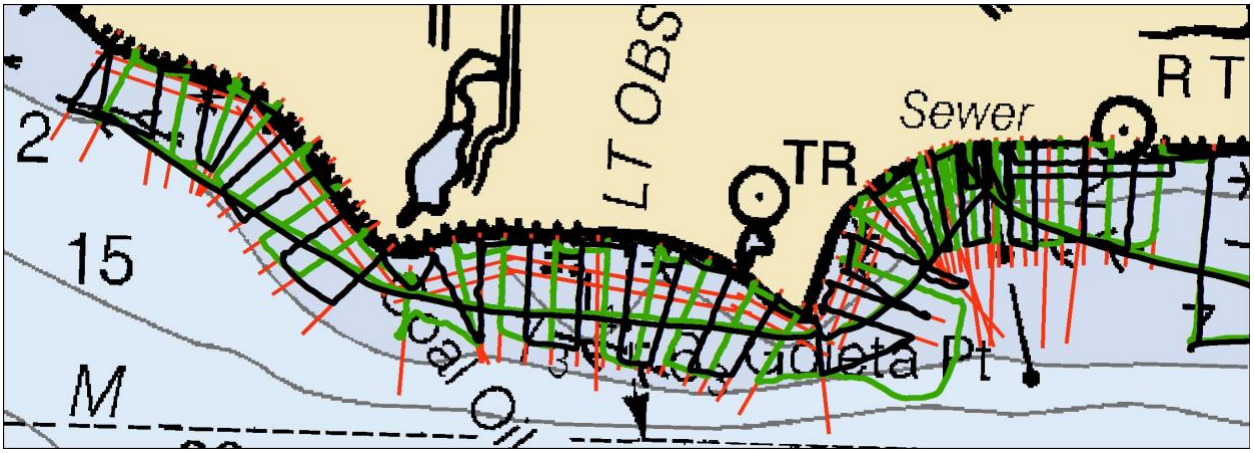

Figure 2. As-surveyed lines, Goleta focus area. Target lines are in red, surveyed lines are in black for black PWC, green for green PWC.

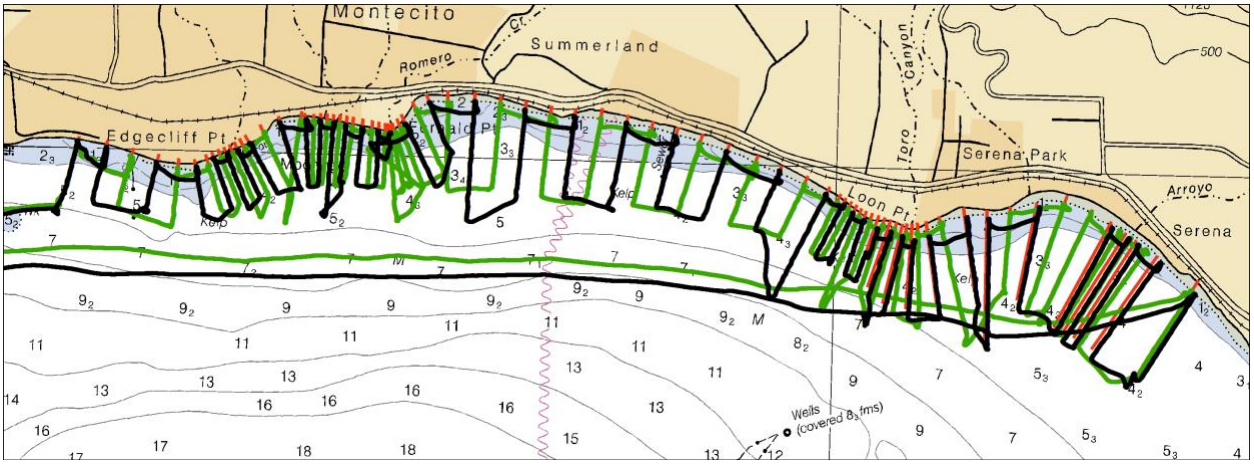

Figure 3. As-surveyed lines, Montecito focus area. Target lines are in red, surveyed lines are in black for black PWC, green for green PWC.

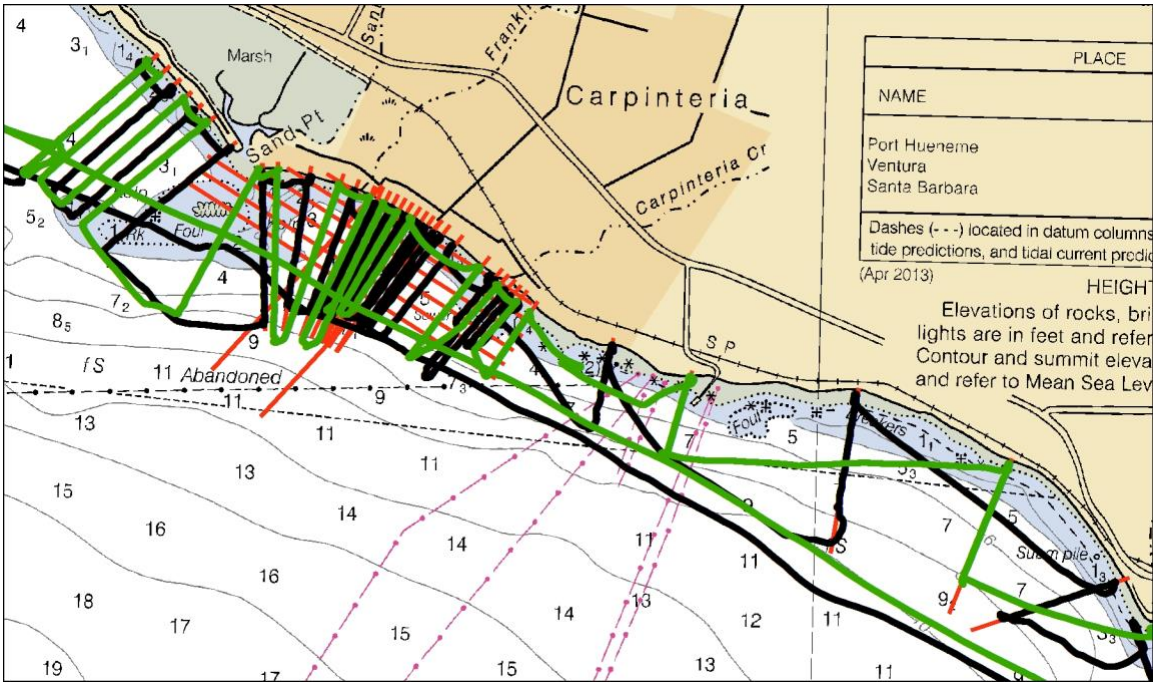

Figure 4. As-surveyed lines, Carpinteria focus area. Target lines are in red, surveyed lines are in black for black PWC, green for green PWC.

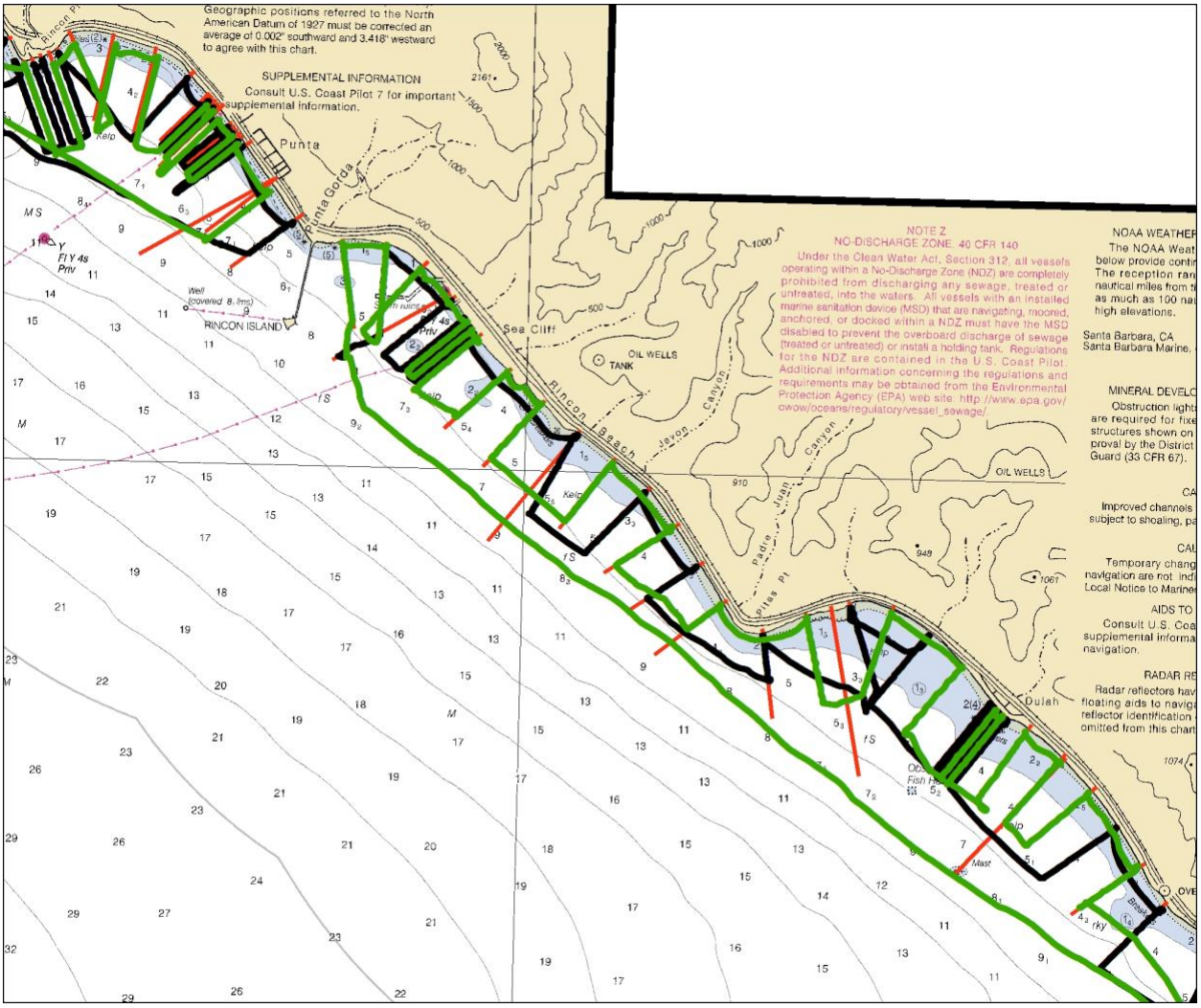

Figure 5. As-surveyed lines, Rincon focus area. Target lines are in red, surveyed lines are in black for black PWC, green for green PWC.

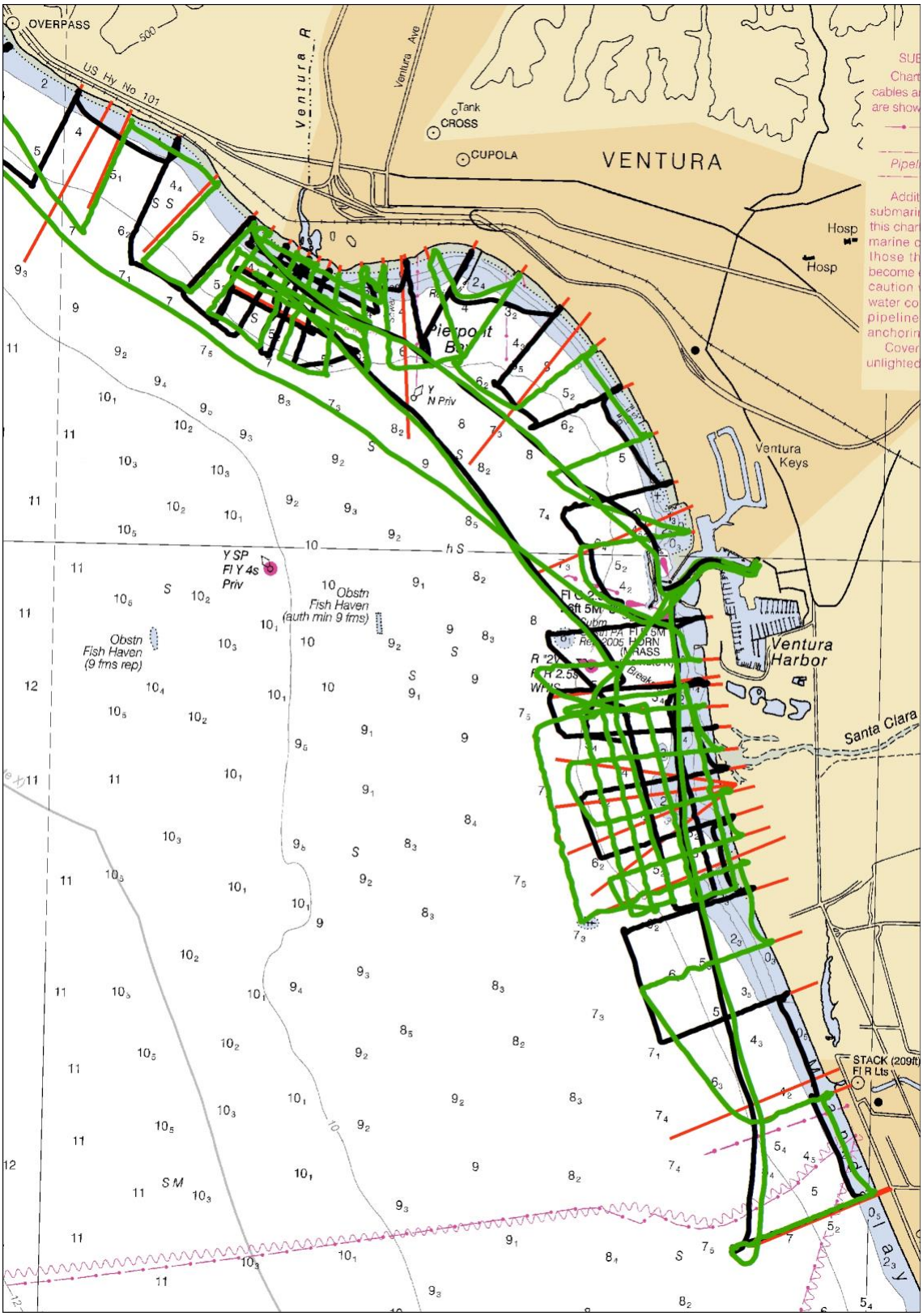

Figure 6. As-surveyed lines, Ventura focus area. Target lines are in red, surveyed lines are in black for black PWC, green for green PWC.

Table 1. As-surveyed line endpoints, Goleta, Black PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
000_0940.RAW	09/27/18 9:40	34.411243	-119.811634	09/27/18 9:44	34.416451	-119.811257
002_0945.RAW	09/27/18 9:45	34.416969	-119.817509	09/27/18 9:50	34.409707	-119.818176
004_0950.RAW	09/27/18 9:50	34.410433	-119.821876	09/27/18 9:55	34.417157	-119.821923
006_0957.RAW	09/27/18 9:57	34.416817	-119.826194	09/27/18 10:01	34.409823	-119.825883
008_1002.RAW	09/27/18 10:02	34.40996	-119.827896	09/27/18 10:07	34.416749	-119.828368
071_1008.RAW	09/27/18 10:08	34.415378	-119.827634	09/27/18 10:14	34.415793	-119.814786
072_1014.RAW	09/27/18 10:14	34.414896	-119.814678	09/27/18 10:21	34.414451	-119.82785
010_1022.RAW	09/27/18 10:22	34.416658	-119.830515	09/27/18 10:26	34.410059	-119.829838
012_1027.RAW	09/27/18 10:27	34.409865	-119.831672	09/27/18 10:31	34.416425	-119.832702
014_1032.RAW	09/27/18 10:32	34.415898	-119.834793	09/27/18 10:36	34.40939	-119.833053
016_1037.RAW	09/27/18 10:37	34.409206	-119.834069	09/27/18 10:37	34.409208	-119.834071
016_1037_0001	09/27/18 10:37	34.409225	-119.834083	09/27/18 10:41	34.41507	-119.836607
018_1042.RAW	09/27/18 10:42	34.413227	-119.840022	09/27/18 10:46	34.408499	-119.835213
020_1049.RAW	09/27/18 10:49	34.407069	-119.831941	09/27/18 10:55	34.41006	-119.841594
022_1059.RAW	09/27/18 10:59	34.404709	-119.834875	09/27/18 11:03	34.406762	-119.843165
023_1105.RAW	09/27/18 11:05	34.405098	-119.843528	09/27/18 11:10	34.403195	-119.836152
024_1112.RAW	09/27/18 11:12	34.400605	-119.843471	09/27/18 11:14	34.404318	-119.84414
026_1115.RAW	09/27/18 11:15	34.405658	-119.847278	09/27/18 11:19	34.400256	-119.850933
028_1120.RAW	09/27/18 11:20	34.40048	-119.854523	09/27/18 11:25	34.407374	-119.851203
030_1127.RAW	09/27/18 11:27	34.408486	-119.855205	09/27/18 11:31	34.400823	-119.857877
032_1132.RAW	09/27/18 11:32	34.401111	-119.860435	09/27/18 11:37	34.408985	-119.859474
034_1138.RAW	09/27/18 11:38	34.409071	-119.863838	09/27/18 11:43	34.401764	-119.864082
036_1144.RAW	09/27/18 11:44	34.402369	-119.868358	09/27/18 11:48	34.409045	-119.868193
038_1149.RAW	09/27/18 11:49	34.408931	-119.872355	09/27/18 11:50	34.406799	-119.872329
038_1152.RAW	09/27/18 11:52	34.408894	-119.872354	09/27/18 11:57	34.402126	-119.872089
040_1202.RAW	09/27/18 12:02	34.402487	-119.872579	09/27/18 12:06	34.407899	-119.876319
042_1208.RAW	09/27/18 12:08	34.407924	-119.880468	09/27/18 12:11	34.404407	-119.884484
044_1214.RAW	09/27/18 12:14	34.407755	-119.888431	09/27/18 12:17	34.410926	-119.883064
046_1219.RAW	09/27/18 12:19	34.413903	-119.885679	09/27/18 12:23	34.409879	-119.892178
048_1224.RAW	09/27/18 12:24	34.412346	-119.893511	09/27/18 12:28	34.416667	-119.888154
050_1229.RAW	09/27/18 12:29	34.418894	-119.89129	09/27/18 12:33	34.413378	-119.895024
052_1233.RAW	09/27/18 12:33	34.414502	-119.896228	09/27/18 12:37	34.420107	-119.895182
054_1238.RAW	09/27/18 12:38	34.420731	-119.899281	09/27/18 12:41	34.415558	-119.900213
056_1248.RAW	09/27/18 12:48	34.417569	-119.906806	09/27/18 12:51	34.422346	-119.903514
009_1304.RAW	09/27/18 13:04	34.413869	-119.829928	09/27/18 13:06	34.416687	-119.830016
010_1307.RAW	09/27/18 13:07	34.416592	-119.830994	09/27/18 13:09	34.413771	-119.830814
011_1310.RAW	09/27/18 13:10	34.413629	-119.831743	09/27/18 13:12	34.41647	-119.832224

Table 2. As-surveyed line endpoints, Goleta, Green PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
000_0936.RAW	09/27/18 9:36	34.407418	-119.811961	09/27/18 9:43	34.4162	-119.811255
001_0945.RAW	09/27/18 9:45	34.416502	-119.815384	09/27/18 9:49	34.411293	-119.815893
003_0951.RAW	09/27/18 9:51	34.410669	-119.819827	09/27/18 9:56	34.41706	-119.819757
005_0958.RAW	09/27/18 9:58	34.416904	-119.823876	09/27/18 10:02	34.410141	-119.823756
007_1004.RAW	09/27/18 10:04	34.409953	-119.826841	09/27/18 10:09	34.416432	-119.827435
069_1012_0002	09/27/18 10:12	34.415317	-119.829407	09/27/18 10:18	34.41259	-119.840676
070_1019.RAW	09/27/18 10:19	34.411663	-119.840999	09/27/18 10:25	34.414371	-119.829452
009_1028.RAW	09/27/18 10:28	34.416352	-119.829579	09/27/18 10:33	34.410046	-119.829054
011_1034.RAW	09/27/18 10:34	34.409978	-119.830781	09/27/18 10:38	34.416605	-119.831661
013_1039.RAW	09/27/18 10:39	34.41599	-119.833511	09/27/18 10:44	34.409586	-119.832415
015_1044.RAW	09/27/18 10:44	34.409296	-119.833444	09/27/18 10:48	34.415607	-119.835672
017_1050.RAW	09/27/18 10:50	34.41393	-119.838255	09/27/18 10:55	34.408826	-119.834545
019_1055.RAW	09/27/18 10:55	34.408387	-119.83484	09/27/18 10:59	34.411665	-119.841062
021_1101.RAW	09/27/18 11:01	34.408435	-119.841602	09/27/18 11:07	34.405705	-119.832291
025_1112.RAW	09/27/18 11:12	34.399787	-119.848781	09/27/18 11:16	34.404871	-119.845504
027_1118.RAW	09/27/18 11:18	34.406442	-119.849477	09/27/18 11:22	34.400217	-119.852891
029_1124.RAW	09/27/18 11:24	34.400876	-119.856541	09/27/18 11:29	34.407928	-119.853208
031_1131.RAW	09/27/18 11:31	34.408699	-119.857181	09/27/18 11:36	34.400751	-119.859122
033_1137.RAW	09/27/18 11:37	34.401181	-119.861588	09/27/18 11:42	34.409061	-119.861731
035_1144.RAW	09/27/18 11:44	34.408787	-119.865917	09/27/18 11:49	34.401977	-119.866214
037_1150.RAW	09/27/18 11:50	34.402891	-119.870456	09/27/18 11:55	34.408977	-119.870487
039_1157.RAW	09/27/18 11:57	34.408374	-119.874302	09/27/18 12:02	34.402099	-119.872547
041_1204.RAW	09/27/18 12:04	34.4021	-119.878687	09/27/18 12:08	34.406433	-119.878254
043_1211.RAW	09/27/18 12:11	34.409283	-119.882087	09/27/18 12:15	34.406248	-119.887302
045_1217.RAW	09/27/18 12:17	34.408944	-119.890194	09/27/18 12:21	34.412447	-119.884496
047_1223.RAW	09/27/18 12:23	34.415008	-119.887077	09/27/18 12:27	34.411401	-119.892558
049_1228.RAW	09/27/18 12:28	34.412902	-119.894674	09/27/18 12:33	34.418031	-119.88966
051_1235.RAW	09/27/18 12:35	34.419432	-119.893135	09/27/18 12:39	34.413753	-119.895473
053_1241.RAW	09/27/18 12:41	34.414772	-119.898394	09/27/18 12:45	34.420337	-119.897353
055_1247.RAW	09/27/18 12:47	34.421061	-119.901629	09/27/18 12:51	34.416572	-119.90453
014_1304.RAW	09/27/18 13:04	34.412468	-119.833287	09/27/18 13:07	34.415984	-119.834095
013_1308.RAW	09/27/18 13:08	34.416149	-119.833263	09/27/18 13:10	34.413378	-119.832577
012_1311_0002	09/27/18 13:11	34.413717	-119.83181	09/27/18 13:13	34.416168	-119.832106

Table 3. As-surveyed line endpoints, Montecito, Black PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
83_BCN12short	09/28/18 10:20	34.413591	-119.648402	09/28/18 10:23	34.417188	-119.647297
082_1024.RAW	09/28/18 10:24	34.416735	-119.64486	09/28/18 10:26	34.413407	-119.645877
080_1028.RAW	09/28/18 10:28	34.412383	-119.641518	09/28/18 10:31	34.4158	-119.640618
078_1032.RAW	09/28/18 10:32	34.415609	-119.637227	09/28/18 10:34	34.412482	-119.636615
076_1035.RAW	09/28/18 10:35	34.413023	-119.634332	09/28/18 10:37	34.416215	-119.635806
074_1038.RAW	09/28/18 10:38	34.416603	-119.634741	09/28/18 10:41	34.412851	-119.632829
072_1041.RAW	09/28/18 10:41	34.413546	-119.631885	09/28/18 10:43	34.416847	-119.63379
070_1045.RAW	09/28/18 10:45	34.417306	-119.632705	09/28/18 10:48	34.414047	-119.630471
068_1048.RAW	09/28/18 10:48	34.414198	-119.628457	09/28/18 10:51	34.418833	-119.630295
066_1054.RAW	09/28/18 10:54	34.419044	-119.628088	09/28/18 10:57	34.414615	-119.627821
064_1057.RAW	09/28/18 10:57	34.414827	-119.626959	09/28/18 11:00	34.419023	-119.626906
062_1101.RAW	09/28/18 11:01	34.418878	-119.625734	09/28/18 11:05	34.412616	-119.626264
060_1110.RAW	09/28/18 11:10	34.414812	-119.625031	09/28/18 11:13	34.418731	-119.624753
058_1114.RAW	09/28/18 11:14	34.418488	-119.623286	09/28/18 11:16	34.414837	-119.623783
056_1117.RAW	09/28/18 11:17	34.414725	-119.622156	09/28/18 11:19	34.41838	-119.621982
050_1139.RAW	09/28/18 11:39	34.418928	-119.619661	09/28/18 11:42	34.414809	-119.617193
048_1143.RAW	09/28/18 11:43	34.417453	-119.616191	09/28/18 11:45	34.420483	-119.617708
046_1147.RAW	09/28/18 11:47	34.420574	-119.61387	09/28/18 11:52	34.4125	-119.6144
044_1153.RAW	09/28/18 11:53	34.41437	-119.610295	09/28/18 11:56	34.420117	-119.60967
042_1200.RAW	09/28/18 12:00	34.419774	-119.605474	09/28/18 12:04	34.414321	-119.606219
040_1209.RAW	09/28/18 12:09	34.414074	-119.602308	09/28/18 12:13	34.419392	-119.601079
038_1215.RAW	09/28/18 12:15	34.418509	-119.596905	09/28/18 12:19	34.413795	-119.598412
036_1220.RAW	09/28/18 12:20	34.413018	-119.594462	09/28/18 12:22	34.417599	-119.592597
034_1224.RAW	09/28/18 12:24	34.416317	-119.58809	09/28/18 12:27	34.412417	-119.589993
032_1228.RAW	09/28/18 12:28	34.407524	-119.588463	09/28/18 12:33	34.414775	-119.584135
030_1235.RAW	09/28/18 12:35	34.414041	-119.582614	09/28/18 12:38	34.410626	-119.584838
028_1239.RAW	09/28/18 12:39	34.410014	-119.583771	09/28/18 12:41	34.413507	-119.581847
026_1242.RAW	09/28/18 12:42	34.413015	-119.580858	09/28/18 12:45	34.409347	-119.582393
024_1245.RAW	09/28/18 12:45	34.408858	-119.581483	09/28/18 12:48	34.412873	-119.579899
022_1249.RAW	09/28/18 12:49	34.412654	-119.578768	09/28/18 12:52	34.408347	-119.580496
020_1259.RAW	09/28/18 12:59	34.407152	-119.579313	09/28/18 13:02	34.412362	-119.57778
018_1304.RAW	09/28/18 13:04	34.412099	-119.576758	09/28/18 13:07	34.406916	-119.577192
016_1308.RAW	09/28/18 13:08	34.407186	-119.574579	09/28/18 13:11	34.412439	-119.575514
014_1312.RAW	09/28/18 13:12	34.413746	-119.572367	09/28/18 13:16	34.40821	-119.571403
010_1317.RAW	09/28/18 13:17	34.404751	-119.570416	09/28/18 13:23	34.413738	-119.570548
012_1324.RAW	09/28/18 13:24	34.414599	-119.56629	09/28/18 13:28	34.407729	-119.567879
008_1330.RAW	09/28/18 13:30	34.405919	-119.564744	09/28/18 13:35	34.413328	-119.560123
006_1336.RAW	09/28/18 13:36	34.412558	-119.558717	09/28/18 13:42	34.405477	-119.564047

004_1343.RAW	09/28/18 13:43	34.405061	-119.563139	09/28/18 13:48	34.412173	-119.557917
002_1350.RAW	09/28/18 13:50	34.411008	-119.555976	09/28/18 13:55	34.404439	-119.561521
1_BCN15short	09/28/18 14:01	34.402847	-119.55754	09/28/18 14:05	34.408834	-119.553044

Table 4. As-surveyed line endpoints, Montecito, Green PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
83_BCN12short	09/28/18 10:16	34.41344	-119.648472	09/28/18 10:19	34.417075	-119.647299
081_1021.RAW	09/28/18 10:21	34.415991	-119.642642	09/28/18 10:24	34.413035	-119.643725
079_1026.RAW	09/28/18 10:26	34.411439	-119.639256	09/28/18 10:29	34.415491	-119.638842
077_1032.RAW	09/28/18 10:32	34.415595	-119.636327	09/28/18 10:34	34.412901	-119.63516
075_1035.RAW	09/28/18 10:35	34.413001	-119.633636	09/28/18 10:38	34.416395	-119.635182
073_1038.RAW	09/28/18 10:38	34.416605	-119.634235	09/28/18 10:42	34.412344	-119.631831
071_1042.RAW	09/28/18 10:42	34.413655	-119.631171	09/28/18 10:45	34.417111	-119.63317
069_1046.RAW	09/28/18 10:46	34.417986	-119.631651	09/28/18 10:50	34.414254	-119.62934
67_BCN13short	09/28/18 10:51	34.411869	-119.629626	09/28/18 10:56	34.419083	-119.628568
065_1057.RAW	09/28/18 10:57	34.418878	-119.627399	09/28/18 11:00	34.414709	-119.627419
063_1101.RAW	09/28/18 11:01	34.414719	-119.626631	09/28/18 11:04	34.418912	-119.626162
061_1104.RAW	09/28/18 11:04	34.41854	-119.625435	09/28/18 11:08	34.414713	-119.625594
059_1108.RAW	09/28/18 11:08	34.414814	-119.62484	09/28/18 11:11	34.418695	-119.624321
057_1112.RAW	09/28/18 11:12	34.418389	-119.622809	09/28/18 11:15	34.414594	-119.62285
055_1116.RAW	09/28/18 11:16	34.414569	-119.621516	09/28/18 11:18	34.418201	-119.621527
053_1119.RAW	09/28/18 11:19	34.418286	-119.620581	09/28/18 11:22	34.414588	-119.619799
052_1124.RAW	09/28/18 11:24	34.414666	-119.619187	09/28/18 11:27	34.41839	-119.620594
051_1128.RAW	09/28/18 11:28	34.418664	-119.619895	09/28/18 11:32	34.414754	-119.618201
054_1139.RAW	09/28/18 11:39	34.418219	-119.620896	09/28/18 11:43	34.412319	-119.620294
049_1147.RAW	09/28/18 11:47	34.415348	-119.616295	09/28/18 11:51	34.420053	-119.618868
047_1152.RAW	09/28/18 11:52	34.420458	-119.615955	09/28/18 11:56	34.414602	-119.616085
045_1158.RAW	09/28/18 11:58	34.414697	-119.612362	09/28/18 12:01	34.420566	-119.611821
043_1203.RAW	09/28/18 12:03	34.419702	-119.607421	09/28/18 12:07	34.414348	-119.608131
041_1208.RAW	09/28/18 12:08	34.414023	-119.604422	09/28/18 12:12	34.419717	-119.603344
039_1216.RAW	09/28/18 12:16	34.418881	-119.59896	09/28/18 12:19	34.413979	-119.60036
37_BCN14short	09/28/18 12:20	34.413243	-119.596632	09/28/18 12:23	34.418145	-119.59499
035_1229.RAW	09/28/18 12:29	34.416908	-119.590135	09/28/18 12:32	34.412793	-119.59212
033_1233.RAW	09/28/18 12:33	34.411795	-119.588034	09/28/18 12:35	34.415375	-119.586058
031_1237.RAW	09/28/18 12:37	34.414138	-119.583144	09/28/18 12:40	34.410916	-119.585279
029_1240.RAW	09/28/18 12:40	34.410477	-119.584345	09/28/18 12:42	34.413872	-119.582292
027_1243.RAW	09/28/18 12:43	34.413212	-119.581273	09/28/18 12:48	34.407077	-119.584339
025_1249.RAW	09/28/18 12:49	34.409152	-119.582053	09/28/18 12:52	34.412975	-119.580435
023_1253.RAW	09/28/18 12:53	34.41277	-119.579238	09/28/18 12:56	34.408439	-119.581071
021_1258.RAW	09/28/18 12:58	34.406663	-119.580454	09/28/18 13:02	34.412556	-119.578401
019_1304.RAW	09/28/18 13:04	34.412138	-119.57717	09/28/18 13:07	34.406896	-119.578266
017_1308.RAW	09/28/18 13:08	34.405805	-119.576093	09/28/18 13:12	34.412212	-119.5764
015_1314.RAW	09/28/18 13:14	34.412946	-119.57422	09/28/18 13:19	34.405166	-119.572006
011_1321.RAW	09/28/18 13:21	34.408253	-119.568972	09/28/18 13:26	34.413874	-119.568574

013_1328.RAW	09/28/18 13:28	34.414453	-119.563973	09/28/18 13:33	34.406971	-119.566992
009_1334.RAW	09/28/18 13:34	34.406202	-119.565976	09/28/18 13:39	34.414049	-119.561837
007_1341.RAW	09/28/18 13:41	34.412724	-119.559213	09/28/18 13:47	34.405674	-119.564349
005_1348.RAW	09/28/18 13:48	34.405426	-119.5636	09/28/18 13:53	34.412273	-119.558461
003_1354.RAW	09/28/18 13:54	34.411359	-119.556942	09/28/18 13:59	34.404813	-119.56251
1_BCN15short	09/28/18 14:01	34.40274	-119.557627	09/28/18 14:05	34.408678	-119.553244

Table 5. As-surveyed line endpoints, Carpinteria, Black PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
033_0921.RAW	09/24/18 9:21	34.395635	-119.551998	09/24/18 9:26	34.401638	-119.544003
031_0928.RAW	09/24/18 9:28	34.400291	-119.542356	09/24/18 9:33	34.394719	-119.549938
029_0934.RAW	09/24/18 9:34	34.393284	-119.548731	09/24/18 9:39	34.399129	-119.540968
027_0940.RAW	09/24/18 9:40	34.397155	-119.538547	09/24/18 9:45	34.391549	-119.546569
025_0947.RAW	09/24/18 9:47	34.387749	-119.536078	09/24/18 9:52	34.395911	-119.536464
023_0954.RAW	09/24/18 9:54	34.395668	-119.533238	09/24/18 9:58	34.388996	-119.534586
021_0958.RAW	09/24/18 9:58	34.388502	-119.533208	09/24/18 10:02	34.39508	-119.530406
019_1004.RAW	09/24/18 10:04	34.394385	-119.528983	09/24/18 10:08	34.388622	-119.53218
017_1008.RAW	09/24/18 10:08	34.388589	-119.531482	09/24/18 10:12	34.394193	-119.527983
015_1013.RAW	09/24/18 10:13	34.393678	-119.527099	09/24/18 10:17	34.388601	-119.530747
013_1017.RAW	09/24/18 10:17	34.388214	-119.53001	09/24/18 10:17	34.388579	-119.529719
013_1017_0001	09/24/18 10:17	34.388584	-119.529717	09/24/18 10:21	34.393343	-119.526216
011_1022.RAW	09/24/18 10:22	34.392854	-119.525275	09/24/18 10:26	34.387902	-119.529503
012_1026.RAW	09/24/18 10:26	34.388526	-119.529482	09/24/18 10:30	34.393109	-119.525769
010_1030.RAW	09/24/18 10:30	34.392549	-119.524791	09/24/18 10:34	34.387854	-119.529122
009_1035.RAW	09/24/18 10:35	34.387259	-119.528264	09/24/18 10:38	34.39219	-119.523983
007_1040.RAW	09/24/18 10:40	34.390419	-119.52117	09/24/18 10:41	34.390406	-119.521358
007_1041.RAW	09/24/18 10:41	34.390603	-119.521485	09/24/18 10:44	34.38823	-119.523548
007_1045.RAW	09/24/18 10:45	34.385183	-119.525305	09/24/18 10:49	34.389888	-119.520509
007_1050.RAW	09/24/18 10:50	34.389188	-119.519562	09/24/18 10:53	34.386794	-119.522417
007_1054.RAW	09/24/18 10:54	34.387134	-119.522562	09/24/18 10:55	34.389593	-119.520139
005_1100.RAW	09/24/18 11:00	34.382647	-119.514572	09/24/18 11:03	34.387075	-119.513366
003_1107.RAW	09/24/18 11:07	34.378479	-119.498395	09/24/18 11:11	34.384755	-119.497468
001_1114.RAW	09/24/18 11:14	34.374916	-119.480426	09/24/18 11:18	34.372958	-119.487384

Table 6. As-surveyed line endpoints, Carpinteria, Green PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
033_0922.RAW	09/24/18 9:22	34.395546	-119.551911	09/24/18 9:27	34.40182	-119.544019
032_0928.RAW	09/24/18 9:28	34.401058	-119.543433	09/24/18 9:33	34.39534	-119.55072
030_0933.RAW	09/24/18 9:33	34.393965	-119.549487	09/24/18 9:38	34.399835	-119.541583
028_0939.RAW	09/24/18 9:39	34.398636	-119.540622	09/24/18 9:45	34.393024	-119.54789
026_0946.RAW	09/24/18 9:46	34.388206	-119.541776	09/24/18 9:52	34.396024	-119.536728
024_0953.RAW	09/24/18 9:53	34.395896	-119.535834	09/24/18 9:59	34.387381	-119.535425
022_1003.RAW	09/24/18 10:03	34.387357	-119.53458	09/24/18 10:08	34.395385	-119.531377
020_1009.RAW	09/24/18 10:09	34.394734	-119.53004	09/24/18 10:14	34.387091	-119.533491
018_1019.RAW	09/24/18 10:19	34.388642	-119.531662	09/24/18 10:19	34.38886	-119.531592
018_1022.RAW	09/24/18 10:22	34.38862	-119.531802	09/24/18 10:27	34.394473	-119.528567
016_1027.RAW	09/24/18 10:27	34.39402	-119.527976	09/24/18 10:31	34.388628	-119.531104
014_1031.RAW	09/24/18 10:31	34.388528	-119.530463	09/24/18 10:35	34.393602	-119.526759
008_1036.RAW	09/24/18 10:36	34.391012	-119.522974	09/24/18 10:41	34.386303	-119.526503
007_1042.RAW	09/24/18 10:42	34.387648	-119.523658	09/24/18 10:45	34.390161	-119.520889
007_1045.RAW	09/24/18 10:45	34.389355	-119.520146	09/24/18 10:48	34.386757	-119.52223
006_1048.RAW	09/24/18 10:48	34.385268	-119.521541	09/24/18 10:51	34.388694	-119.518779
004_1056.RAW	09/24/18 10:56	34.385162	-119.508163	09/24/18 10:59	34.381445	-119.509636

Table 7. As-surveyed line endpoints, Rincon, Black PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
35_1.RAW	09/24/18 11:23	34.37292	-119.479099	09/24/18 11:29	34.364136	-119.475205
035_1130.RAW	09/24/18 11:30	34.364811	-119.473153	09/24/18 11:35	34.372609	-119.476773
35_3.RAW	09/24/18 11:35	34.373044	-119.475721	09/24/18 11:40	34.365122	-119.472152
35_5.RAW	09/24/18 11:41	34.365814	-119.47014	09/24/18 11:46	34.373826	-119.473827
031_1148.RAW	09/24/18 11:48	34.36543	-119.464751	09/24/18 11:52	34.371574	-119.458348
30_3.RAW	09/24/18 11:53	34.369313	-119.455788	09/24/18 11:57	34.364968	-119.461159
30_1.RAW	09/24/18 11:58	34.364429	-119.460324	09/24/18 12:01	34.368687	-119.455146
29_4.RAW	09/24/18 12:03	34.366404	-119.453173	09/24/18 12:03	34.366252	-119.453607
29_5.RAW	09/24/18 12:04	34.366814	-119.453381	09/24/18 12:08	34.36334	-119.458715
29_3.RAW	09/24/18 12:08	34.362608	-119.458094	09/24/18 12:11	34.36622	-119.452817
29_1.RAW	09/24/18 12:12	34.365426	-119.452095	09/24/18 12:16	34.361937	-119.45739
029_1218.RAW	09/24/18 12:18	34.36026	-119.459184	09/24/18 12:23	34.36487	-119.451526
027_1225.RAW	09/24/18 12:25	34.357485	-119.445234	09/24/18 12:29	34.354523	-119.45015
025_0951.RAW	09/26/18 9:51	34.346891	-119.434474	09/26/18 9:56	34.35474	-119.433994
023_1000.RAW	09/26/18 10:00	34.350032	-119.426049	09/26/18 10:06	34.344718	-119.433783
22_5.RAW	09/26/18 10:07	34.343349	-119.431511	09/26/18 10:12	34.348339	-119.424411
22_5_0001.RAW	09/26/18 10:12	34.348345	-119.424407	09/26/18 10:12	34.348263	-119.424661
22_3.RAW	09/26/18 10:13	34.347425	-119.4237	09/26/18 10:17	34.342655	-119.430778
22_1.RAW	09/26/18 10:18	34.341985	-119.430067	09/26/18 10:22	34.34681	-119.423207
019_1025.RAW	09/26/18 10:25	34.336991	-119.410411	09/26/18 10:30	34.329219	-119.415844
017_1032.RAW	09/26/18 10:32	34.325444	-119.409161	09/26/18 10:33	34.326392	-119.407991
017_1033.RAW	09/26/18 10:33	34.326403	-119.407971	09/26/18 10:37	34.331431	-119.402212
015_1040.RAW	09/26/18 10:40	34.324128	-119.395885	09/26/18 10:44	34.321074	-119.401494
013_1046.RAW	09/26/18 10:46	34.31304	-119.386846	09/26/18 10:48	34.31746	-119.387594
011_1055.RAW	09/26/18 10:55	34.312366	-119.37395	09/26/18 11:00	34.320433	-119.37717
009_1103.RAW	09/26/18 11:03	34.317859	-119.367715	09/26/18 11:07	34.311074	-119.37441
007_1109.RAW	09/26/18 11:09	34.304321	-119.366878	09/26/18 11:14	34.311257	-119.360224
006_1115.RAW	09/26/18 11:15	34.31078	-119.359699	09/26/18 11:20	34.304063	-119.366368
006_1120.RAW	09/26/18 11:20	34.303493	-119.365521	09/26/18 11:25	34.31026	-119.359171
006_1126.RAW	09/26/18 11:26	34.30966	-119.35822	09/26/18 11:31	34.302958	-119.364624
003_1134.RAW	09/26/18 11:34	34.294106	-119.353229	09/26/18 11:39	34.299126	-119.344821
001_1142.RAW	09/26/18 11:41	34.291038	-119.338964	09/26/18 11:47	34.285443	-119.346018

Table 8. As-surveyed line endpoints, Rincon, Green PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
35_2_0001.RAW	09/24/18 11:16	34.372377	-119.477983	09/24/18 11:22	34.364587	-119.47424
35_4.RAW	09/24/18 11:27	34.365372	-119.471178	09/24/18 11:32	34.373437	-119.474679
034_1133.RAW	09/24/18 11:33	34.375028	-119.472812	09/24/18 11:39	34.36803	-119.467782
033_1140.RAW	09/24/18 11:40	34.366945	-119.469452	09/24/18 11:45	34.375547	-119.467303
032_1148.RAW	09/24/18 11:48	34.374218	-119.462542	09/24/18 11:54	34.365916	-119.464664
30_4.RAW	09/24/18 11:55	34.365091	-119.46184	09/24/18 11:59	34.369715	-119.456321
30_2.RAW	09/24/18 12:01	34.368966	-119.455888	09/24/18 12:04	34.364521	-119.460992
030_1205.RAW	09/24/18 12:05	34.362723	-119.461596	09/24/18 12:10	34.368224	-119.454722
29_4_0001.RAW	09/24/18 12:11	34.366527	-119.453341	09/24/18 12:15	34.36302	-119.458326
29_2_0001.RAW	09/24/18 12:16	34.362245	-119.457818	09/24/18 12:19	34.365916	-119.452541
028_1221.RAW	09/24/18 12:21	34.361296	-119.44912	09/24/18 12:26	34.356323	-119.455881
026_0939.RAW	09/26/18 9:39	34.348374	-119.437898	09/26/18 9:43	34.355632	-119.43927
025_0944.RAW	09/26/18 9:44	34.355392	-119.433855	09/26/18 9:49	34.346452	-119.434626
024_0950.RAW	09/26/18 9:50	34.347351	-119.436045	09/26/18 9:55	34.353282	-119.429818
22_4.RAW	09/26/18 10:01	34.347946	-119.423995	09/26/18 10:05	34.343056	-119.431025
22_2.RAW	09/26/18 10:05	34.342445	-119.430271	09/26/18 10:10	34.347283	-119.423417
022_1011.RAW	09/26/18 10:11	34.346367	-119.422753	09/26/18 10:15	34.341396	-119.429867
021_1017.RAW	09/26/18 10:17	34.338572	-119.425149	09/26/18 10:21	34.34319	-119.419001
020_1022.RAW	09/26/18 10:22	34.340071	-119.414957	09/26/18 10:27	34.334572	-119.420763
018_1029.RAW	09/26/18 10:29	34.328724	-119.411433	09/26/18 10:32	34.334431	-119.406141
016_1035.RAW	09/26/18 10:35	34.328162	-119.398956	09/26/18 10:39	34.324203	-119.405451
014_1041.RAW	09/26/18 10:41	34.317968	-119.396647	09/26/18 10:44	34.320568	-119.392795
012_1047.RAW	09/26/18 10:47	34.319403	-119.382456	09/26/18 10:52	34.311027	-119.380272
010_1053.RAW	09/26/18 10:53	34.311741	-119.375716	09/26/18 10:57	34.32012	-119.372313
008_1100.RAW	09/26/18 11:00	34.314804	-119.36374	09/26/18 11:05	34.308188	-119.370409
006_1108.RAW	09/26/18 11:08	34.303835	-119.365905	09/26/18 11:13	34.310602	-119.359469
006_1114.RAW	09/26/18 11:14	34.310011	-119.358656	09/26/18 11:18	34.303254	-119.365059
006_1121.RAW	09/26/18 11:21	34.301944	-119.361272	09/26/18 11:25	34.308585	-119.355874
005_1127.RAW	09/26/18 11:27	34.305594	-119.351634	09/26/18 11:32	34.299581	-119.357976
004_1133.RAW	09/26/18 11:33	34.297221	-119.355411	09/26/18 11:38	34.302696	-119.348141
002_1140.RAW	09/26/18 11:40	34.295417	-119.342289	09/26/18 11:44	34.291262	-119.348672

Table 9. As-surveyed line endpoints, Ventura, Black PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
001_0905.RAW	09/25/18 9:05	34.193988	-119.2588	09/25/18 9:09	34.197067	-119.251064
003_0916.RAW	09/25/18 9:16	34.213728	-119.258636	09/25/18 9:23	34.209517	-119.270909
005_0925.RAW	09/25/18 9:25	34.218679	-119.274733	09/25/18 9:32	34.222454	-119.262293
007_0935.RAW	09/25/18 9:35	34.228367	-119.264496	09/25/18 9:41	34.224741	-119.277441
009_0943.RAW	09/25/18 9:43	34.229878	-119.27944	09/25/18 9:50	34.232354	-119.265281
011_0952.RAW	09/25/18 9:52	34.23576	-119.266572	09/25/18 9:59	34.23475	-119.281317
013_1001.RAW	09/25/18 10:01	34.23852	-119.282428	09/25/18 10:09	34.239392	-119.267414
047_1010.RAW	09/25/18 10:10	34.237836	-119.271269	09/25/18 10:21	34.222036	-119.266115
049_1022.RAW	09/25/18 10:22	34.221117	-119.270303	09/25/18 10:31	34.236973	-119.275606
015_1034.RAW	09/25/18 10:34	34.243225	-119.28345	09/25/18 10:41	34.244873	-119.268068
017_1045.RAW	09/25/18 10:45	34.253677	-119.281691	09/25/18 10:51	34.256061	-119.271514
019_1054.RAW	09/25/18 10:54	34.263894	-119.276861	09/25/18 10:59	34.260388	-119.285407
021_1106.RAW	09/25/18 11:06	34.263942	-119.28919	09/25/18 11:11	34.270246	-119.283033
023_1114.RAW	09/25/18 11:14	34.274895	-119.292021	09/25/18 11:19	34.267781	-119.296571
025_1120.RAW	09/25/18 11:20	34.265744	-119.296495	09/25/18 11:25	34.273948	-119.298666
041_1130.RAW	09/25/18 11:30	34.269706	-119.301671	09/25/18 11:36	34.27498	-119.314325
035_1141.RAW	09/25/18 11:41	34.2772	-119.314066	09/25/18 11:41	34.277179	-119.31433
035_1141_0001	09/25/18 11:41	34.277194	-119.314186	09/25/18 11:47	34.271003	-119.320891
033_1148.RAW	09/25/18 11:48	34.26767	-119.315534	09/25/18 11:53	34.274995	-119.310625
031_1155.RAW	09/25/18 11:55	34.274007	-119.308343	09/25/18 12:04	34.265962	-119.312143
031_1204.RAW	09/25/18 12:04	34.265973	-119.312136	09/25/18 12:09	34.273893	-119.308531
029_1211.RAW	09/25/18 12:11	34.273018	-119.306233	09/25/18 12:17	34.265305	-119.309691
045_1219.RAW	09/25/18 12:19	34.266386	-119.303452	09/25/18 12:26	34.271819	-119.316397
043_1233.RAW	09/25/18 12:33	34.273545	-119.315513	09/25/18 12:35	34.272699	-119.313716
049_1312.RAW	09/25/18 13:12	34.237095	-119.275524	09/25/18 13:20	34.224261	-119.271331
039_1151.RAW	09/26/18 11:51	34.279838	-119.33634	09/26/18 11:56	34.287469	-119.331923
037_1158.RAW	09/26/18 11:58	34.28372	-119.321805	09/26/18 12:03	34.27567	-119.32618
035_1209.RAW	09/26/18 12:09	34.271301	-119.320929	09/26/18 12:13	34.277196	-119.314381

Table 10. As-surveyed line endpoints, Ventura, Green PWC

	Start			End		
Line	Date/time (PDT)	Lat	Lon	Date/time (PDT)	Lat	Lon
001_0856.RAW	09/25/18 8:56	34.192231	-119.263601	09/25/18 8:56	34.192241	-119.263601
001_0904.RAW	09/25/18 9:04	34.193711	-119.259557	09/25/18 9:09	34.197515	-119.249413
002_0913.RAW	09/25/18 9:13	34.205426	-119.254067	09/25/18 9:17	34.203039	-119.261761
004_0919.RAW	09/25/18 9:19	34.214033	-119.272851	09/25/18 9:26	34.218132	-119.260241
005_0929.RAW	09/25/18 9:29	34.224664	-119.263032	09/25/18 9:29	34.224584	-119.263048
005_0930.RAW	09/25/18 9:30	34.224687	-119.263191	09/25/18 9:36	34.220846	-119.275293
006_0937.RAW	09/25/18 9:37	34.223149	-119.276093	09/25/18 9:43	34.226926	-119.263515
008_0944.RAW	09/25/18 9:44	34.230666	-119.265092	09/25/18 9:51	34.227508	-119.278041
010_0952.RAW	09/25/18 9:52	34.232555	-119.280724	09/25/18 9:59	34.234046	-119.265719
012_1001.RAW	09/25/18 10:01	34.237547	-119.267895	09/25/18 10:08	34.236747	-119.281281
046_1011.RAW	09/25/18 10:11	34.238385	-119.269314	09/25/18 10:20	34.222605	-119.264054
048_1021.RAW	09/25/18 10:21	34.221679	-119.268198	09/25/18 10:30	34.237267	-119.273394
014_1034.RAW	09/25/18 10:34	34.240547	-119.282904	09/25/18 10:41	34.241302	-119.268165
016_1045.RAW	09/25/18 10:45	34.2506	-119.279871	09/25/18 10:50	34.2521	-119.269644
018_1053.RAW	09/25/18 10:53	34.256756	-119.282893	09/25/18 10:58	34.260031	-119.273591
020_1100.RAW	09/25/18 11:00	34.267187	-119.279438	09/25/18 11:05	34.26215	-119.286799
022_1107.RAW	09/25/18 11:07	34.266427	-119.292372	09/25/18 11:12	34.273083	-119.287204
024_1114.RAW	09/25/18 11:14	34.274968	-119.295727	09/25/18 11:19	34.266665	-119.292943
026_1121.RAW	09/25/18 11:21	34.265351	-119.299982	09/25/18 11:27	34.273551	-119.300855
040_1130.RAW	09/25/18 11:30	34.270521	-119.301275	09/25/18 11:37	34.276013	-119.314028
034_1141.RAW	09/25/18 11:41	34.27602	-119.312526	09/25/18 11:46	34.269493	-119.318363
032_1148.RAW	09/25/18 11:48	34.266792	-119.313076	09/25/18 11:53	34.274512	-119.309611
030_1154.RAW	09/25/18 11:54	34.273508	-119.30765	09/25/18 11:59	34.265852	-119.311136
028_1200.RAW	09/25/18 12:00	34.264745	-119.306496	09/25/18 12:05	34.27277	-119.305405
027_1207.RAW	09/25/18 12:07	34.273326	-119.302517	09/25/18 12:12	34.264889	-119.302282
044_1213.RAW	09/25/18 12:13	34.267393	-119.303368	09/25/18 12:20	34.272791	-119.316291
042_1222.RAW	09/25/18 12:22	34.274382	-119.315234	09/25/18 12:29	34.268923	-119.302286
043_1230.RAW	09/25/18 12:30	34.268166	-119.302845	09/25/18 12:35	34.272706	-119.313702
052_1236.RAW	09/25/18 12:36	34.272357	-119.31314	09/25/18 12:36	34.272363	-119.313127
052_1245.RAW	09/25/18 12:45	34.234739	-119.284595	09/25/18 12:54	34.219563	-119.279591
050_1257.RAW	09/25/18 12:57	34.220678	-119.272428	09/25/18 13:06	34.236923	-119.27787
051_1308.RAW	09/25/18 13:08	34.236049	-119.279772	09/25/18 13:17	34.2202	-119.274489
049_1318.RAW	09/25/18 13:18	34.221395	-119.270485	09/25/18 13:20	34.22424	-119.271338
038_1154.RAW	09/26/18 11:54	34.27762	-119.330898	09/26/18 12:00	34.285717	-119.326817
036_1201.RAW	09/26/18 12:01	34.280578	-119.317955	09/26/18 12:07	34.274169	-119.325246
035_1208.RAW	09/26/18 12:08	34.271565	-119.320433	09/26/18 12:12	34.27744	-119.314243

Appendix A: Weather Observation Forms

Date: 9/24/18 Carpinteria/N Rincon **Monitor:** __Tehranirad/Finzi-Hart_____

Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
0900 – 1300 PDT	34.35452 to 34.40106	-119.55200 to -119.44523	surveying	overcast	100	none	10 km	4-6 kts	Sm wavelets	0.5 m	

Date: 9/25/18 Ventura _____ **Monitor:** __Brown/Tehranirad/Hoover___

Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
0830 – 1330 PDT	34.19707 to 34.27718	-119.31553 to -119.25864	surveying	overcast	100	none	10 km	1-3 kts	ripples	0.5 m	

Date: 9/26/18 N Vent and S Rincon **Monitor:** __ Brown/Tehranirad/Hoover____

Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
0930 – 1300 PDT	34.27417 to 34.35563	-119.43790 to -119.31796	surveying	sunny	10	moderate	10 km	4-6 kts	Sm wavelets	0.5 - 1m	

Date: 9/27/18 Goleta _____ **Monitor:** __ Brown/Tehranirad/Snyder ___

Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
0900 – 1330 PDT	34.39979 to 34.42235	-119.90681 to -119.81126	surveying	Lt fog	100	none	3 km	1-3 kts	Rippled	0.5m	

Date: 9/28/18 Montecito _____ **Monitor:** __ Brown/Tehranirad/Hoover ___

Time	Latitude	Longitude	Vessel Activity	Weather	Cloud Cover	Glare	Visibility	Wind Speed	Sea State	Swell Height	Comments
1000 – 1430 PDT	34.40274 to 34.42057	-119.64847 to -119.55304	surveying	Overcast, hazy	100	moderate	3 km	<1 kts	Glassy	0.3m	

Appendix B: Marine Wildlife Observations

Date: 9/24-28/18 _____ Monitor: Various (see weather logs)

Dolphins were observed on 3 occasions (see below), but not in close proximity to the PWCs and no behavioral change was observed due to PWC activities. There were no observations of whales or unusual aggregations of seabirds.

9/24/18 10:27 Carpinteria L12: Dolphins seen

9/24/18 10:35 Carpinteria L9: Dolphin at end of line

9/28/18 12:29 Montecito L32: Dolphin N of line

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
Air Quality and Greenhouse Gas (GHG) Emissions (MND Section 3.3.3)						
MM AIR-1: **Engine Tuning, Engine Certification, and Fuels**. The following measures will be required to be implemented by all Permittees under the Offshore Geophysical Permit Program (OGPP), as applicable depending on the county offshore which a survey is being conducted. Pursuant to section 93118.5 of CARB's Airborne Toxic Control Measures, the Tier 2 engine requirement applies only to diesel-fueled vessels.	All Counties: Maintain all construction equipment in proper tune according to manufacturers' specifications; fuel all off-road and portable diesel-powered equipment with California Air Resources Board (CARB)-certified motor vehicle diesel fuel limiting sulfur content to 15 parts per million or less (CARB Diesel).	Daily emissions of criteria pollutants during survey activities are minimized.	Determine engine certification of vessel engines. Review engine emissions data to assess compliance, determine if changes in tuning or fuel are required.	OGPP permit holder and contract vessel operator; California State Lands Commission (CSLC) review of Final Monitoring Report.	Prior to, during, and after survey activities. Submit Final Monitoring Report after completion of survey activities.	9/3/18 TCE
	Los Angeles and Orange Counties: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner; the survey shall be operated such that daily NO_x emissions do not exceed 100 pounds based on engine certification emission factors. This can be accomplished with Tier 2 engines if daily fuel use is 585 gallons or less, and with Tier 3 engines if daily fuel use is 935 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Calculate daily NO_x emissions to verify compliance with limitations.			
	San Luis Obispo County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 585 gallons or less; all diesel equipment shall not idle for more than 5 minutes; engine use needed to maintain position in the water is not considered idling; diesel idling within 300 meters (1,000 feet) of sensitive receptors is not permitted; use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Verify that Tier 2 or cleaner engines are being used. Inform vessel operator(s) of idling limitation. Investigate availability of alternative fuels.			
	Santa Barbara County: Use vessel engines meeting CARB's Tier 2-certified engines or cleaner, accomplished with Tier 2 engines if daily fuel use is 790 gallons or less.		Verify that Tier 2 or cleaner engines are being used. Investigate availability of alternative fuels.			9/3/18 TCE
	Ventura County: Use alternatively fueled construction equipment on site where feasible, such as compressed natural gas, liquefied natural gas, propane or biodiesel.		Investigate availability of alternative fuels.			

EXHIBIT H

Mitigation Monitoring Program

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-1: Marine Mammal and Sea Turtle Presence – Current Information.	All State waters; prior to commencement of survey operations, the geophysical operator shall: (1) contact the National Oceanic and Atmospheric Administration Long Beach office staff and local whale-watching operations and shall acquire information on the current composition and relative abundance of marine wildlife offshore, and (2) convey sightings data to the vessel operator and crew, survey party chief, and onboard Marine Wildlife Monitors (MWMs) prior to departure. This information will aid the MWMs by providing data on the approximate number and types of organisms that may be in the area.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document contact with appropriate sources. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; Inquiry to NOAA and local whale watching operators.	Prior to survey.	9/3/18 TCE
MM BIO-2: Marine Wildlife Monitors (MWMs).	Except as provided in section 7(h) of the General Permit, a minimum of two (2) qualified MWMs who are experienced in marine wildlife observations shall be onboard the survey vessel throughout both transit and data collection activities. The specific monitoring, observation, and data collection responsibilities shall be identified in the Marine Wildlife Contingency Plan required as part of all Offshore Geophysical Permit Program permits. Qualifications of proposed MWMs shall be submitted to the National Oceanic and Atmospheric Administration (NOAA) and CSLC at least twenty-one (21) days in advance of the survey for their approval by the agencies. Survey operations shall not commence until the CSLC approves the MWMs.	Competent and professional monitoring or marine mammals and sea turtles; compliance with established monitoring policies.	Document contact with and approval by appropriate agencies. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	9/3/18 TCE
MM BIO-3: Safety Zone Monitoring.	Onboard Marine Wildlife Monitors (MWMs) responsible for observations during vessel transit shall be responsible for monitoring during the survey equipment operations. All visual monitoring shall occur from the highest practical vantage point aboard the survey vessel; binoculars shall be used to observe the surrounding area, as appropriate. The MWMs will survey an area (i.e., safety or exclusion zone) based on the equipment used, centered on the sound source (i.e., vessel, towfish), throughout time that the survey equipment is operating. Safety zone radial distances, by equipment type, include:	No adverse effects to marine mammals or sea turtles due to survey activities are observed; compliance with established safety zones.	Compliance with permit requirements (observers); compliance with established safety zones. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	9/3/18 TCE

<table>
<tr><th>Mitigation Measure (MM)</th><th>Location and Scope of Mitigation</th><th>Effectiveness Criteria</th><th>Monitoring or Reporting Action</th><th>Responsible Party</th><th>Timing</th><th>Implementation Date(s) and Initials</th></tr>
<tr><td></td><td>
<table>
<tr><th>Equipment Type</th><th>Safety Zone (radius, m)</th></tr>
<tr><td>Single Beam Echosounder</td><td>50</td></tr>
<tr><td>Multibeam Echosounder</td><td>500</td></tr>
<tr><td>Side-Scan Sonar</td><td>600</td></tr>
<tr><td>Subbottom Profiler</td><td>100</td></tr>
<tr><td>Boomer System</td><td>100</td></tr>
</table>
If the geophysical survey equipment is operated at or above a frequency of 200 kilohertz (kHz), safety zone monitoring and enforcement is not required; however, if geophysical survey equipment operated at a frequency at or above 200 kHz is used simultaneously with geophysical survey equipment less than 200 kHz, then the safety zone for the equipment less than 200 kHz must be monitored. The onboard MWMs shall have authority to stop operations if a mammal or turtle is observed within the specified safety zone and may be negatively affected by survey activities. The MWMs shall also have authority to recommend continuation (or cessation) of operations during periods of limited visibility (i.e., fog, rain) based on the observed abundance of marine wildlife. Periodic reevaluation of weather conditions and reassessment of the continuation/cessation recommendation shall be completed by the onboard MWMs. During operations, if an animal's actions are observed to be irregular, the monitor shall have authority to recommend that equipment be shut down until the animal moves further away from the sound source. If irregular behavior is observed, the equipment shall be shut-off and will be restarted and ramped-up to full power, as applicable, or will not be started until the animal(s) is/are outside of the safety zone or have not been observed for 15 minutes.

For nearshore survey operations utilizing vessels that lack the personnel capacity to hold two (2) MWMs aboard during survey operations, at least twenty-one (21) days prior to the commencement of survey activities, the Permittee may petition the CSLC to conduct survey operations with one (1) MWM aboard. The CSLC will consider such authorization on a case-by-case basis and</td><td></td><td></td><td></td><td></td><td>9/3/18
TCE</td></tr>
</table>

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
	factors the CSLC will consider will include the timing, type, and location of the survey, the size of the vessel, and the availability of alternate vessels for conducting the proposed survey. CSLC authorizations under this subsection will be limited to individual surveys and under any such authorization; the Permittee shall update the MWCP to reflect how survey operations will occur under the authorization.					
MM BIO-4: Limits on Nighttime OGPP Surveys.	All State waters; nighttime survey operations are prohibited under the OGPP, except as provided below. The CSLC will consider the use of single beam echosounders and passive equipment types at night on a case-by-case basis, taking into consideration the equipment specifications, location, timing, and duration of survey activity.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Presurvey request for nighttime operations, including equipment specifications and proposed use schedule. Document equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Approval required before survey is initiated. Monitoring Report following comple-tion of survey.	n/a
MM BIO-5: Soft Start.	All State waters; the survey operator shall use a "soft start" technique at the beginning of survey activities each day (or following a shut down) to allow any marine mammal that may be in the immediate area to leave before the sound sources reach full energy. Surveys shall not commence at nighttime or when the safety zone cannot be effectively monitored. Operators shall initiate each piece of equipment at the lowest practical sound level, increasing output in such a manner as to increase in steps not exceeding approximately 6 decibels (dB) per 5-minute period. During ramp-up, the Marine Wildlife Monitors (MWMs) shall monitor the safety zone. If marine mammals are sighted within or about to enter the safety zone, a power-down or shut down shall be implemented as though the equipment was operating at full power. Initiation of ramp-up procedures from shut down requires that the MWMs be able to visually observe the full safety zone.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Compliance with permit requirements (observers); compliance with safe start procedures. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey.	9/24/18 TCE

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-6: Practical Limitations on Equipment Use and Adherence to Equipment Manufacturer's Routine Maintenance Schedule.	All State waters; geophysical operators shall follow, to the maximum extent possible, the guidelines of Zykov (2013) as they pertain to the use of subbottom profilers and side-scan sonar, including: • Using the highest frequency band possible for the subbottom profiler; • Using the shortest possible pulse length; and • Lowering the pulse rate (pings per second) as much as feasible. Geophysical operators shall consider the potential applicability of these measures to other equipment types (e.g., boomer). Permit holders will conduct routine inspection and maintenance of acoustic-generating equipment to ensure that low energy geophysical equipment used during permitted survey activities remains in proper working order and within manufacturer's equipment specifications. Verification of the date and occurrence of such equipment inspection and maintenance shall be provided in the required presurvey notification to CSLC.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Document initial and during survey equipment settings. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to and during survey.	9/24/18 TCE
MM BIO-7: Avoidance of Pinniped Haul-Out Sites.	The Marine Wildlife Contingency Plan (MWCP) developed and implemented for each survey shall include identification of haul-out sites within or immediately adjacent to the proposed survey area. For surveys within 300 meters (m) of a haul-out site, the MWCP shall further require that: • The survey vessel shall not approach within 91 m of a haul-out site, consistent with National Marine Fisheries Service (NMFS) guidelines; • Survey activity close to haul-out sites shall be conducted in an expedited manner to minimize the potential for disturbance of pinnipeds on land; and • Marine Wildlife Monitors shall monitor pinniped activity onshore as the vessel approaches, observing and reporting on the number of pinnipeds potentially disturbed (e.g., via head lifting, flushing into the water). The purpose of such reporting is to provide CSLC and California Department of Fish and Wildlife (CDFW) with information regarding potential disturbance associated with OGPP surveys.	No adverse effects to pinnipeds at haul outs are observed.	Document pinniped reactions to vessel presence and equipment use. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	10/1/18 TCE

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-8: Reporting Requirements – Collision.	All State waters; if a collision with marine mammal or reptile occurs, the vessel operator shall document the conditions under which the accident occurred, including the following: • Vessel location (latitude, longitude) when the collision occurred; • Date and time of collision; • Speed and heading of the vessel at the time of collision; • Observation conditions (e.g., wind speed and direction, swell height, visibility in miles or kilometers, and presence of rain or fog) at the time of collision; • Species of marine wildlife contacted (if known); • Whether an observer was monitoring marine wildlife at the time of collision; and, • Name of vessel, vessel owner/operator, and captain officer in charge of the vessel at time of collision. After a collision, the vessel shall stop, if safe to do so; however, the vessel is not obligated to stand by and may proceed after confirming that it will not further damage the animal by doing so. The vessel will then immediately communicate by radio or telephone all details to the vessel's base of operations, and shall immediately report the incident. Consistent with Marine Mammal Protection Act requirements, the vessel's base of operations or, if an onboard telephone is available, the vessel captain him/herself, will then immediately call the National Oceanic and Atmospheric Administration (NOAA) Stranding Coordinator to report the collision and follow any subsequent instructions. From the report, the Stranding Coordinator will coordinate subsequent action, including enlisting the aid of marine mammal rescue organizations, if appropriate. From the vessel's base of operations, a telephone call will be placed to the Stranding Coordinator, NOAA National Marine Fisheries Service (NMFS), Southwest Region, Long Beach, to obtain instructions. Although NOAA has primary responsibility for marine mammals in both State and Federal waters, the California Department of Fish and Wildlife (CDFW) will also be advised that an incident has occurred in State waters affecting a protected species.	No adverse effects to marine mammals or sea turtles due to survey activities are observed.	Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Monitoring Report following comple-tion of survey.	10/1/18 

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM BIO-9: Limitations on Survey Operations in Select Marine Protected Areas (MPAs).	All MPAs; prior to commencing survey activities, geophysical operators shall coordinate with the CLSC, California Department of Fish and Wildlife (CDFW), and any other appropriate permitting agency regarding proposed operations within MPAs. The scope and purpose of each survey proposed within a MPA shall be defined by the permit holder, and the applicability of the survey to the allowable MPA activities shall be delineated by the permit holder. If deemed necessary by CDFW, geophysical operators will pursue a scientific collecting permit, or other appropriate authorization, to secure approval to work within a MPA, and shall provide a copy of such authorization to the CSLC as part of the required presurvey notification to CSLC. CSLC, CDFW, and/or other permitting agencies may impose further restrictions on survey activities as conditions of approval.	No adverse effects to MPA resources due to survey activities are observed.	Monitor reactions of wildlife to survey operations; report on shutdown conditions and survey restart. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder; survey permitted by CDFW.	Prior to survey.	9/3/18 TCE
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Permittees shall develop and submit to CSLC staff for review and approval an OSCP that addresses accidental releases of petroleum and/or non-petroleum products during survey operations. Permittees' OSCPs shall include the following information for each vessel to be involved with the survey: • Specific steps to be taken in the event of a spill, including notification names, phone numbers, and locations of: (1) nearby emergency medical facilities, and (2) wildlife rescue/response organizations (e.g., Oiled Wildlife Care Network); • Description of crew training and equipment testing procedures; and • Description, quantities, and location of spill response equipment onboard the vessel.	Reduction in the potential for an accidental spill. Proper and timely response and notification of responsible parties in the event of a spill.	Documentation of proper spill training. Notification of responsible parties in the event of a spill.	OGPP permit holder and contract vessel operator.	Prior to survey.	9/3/18 TCE
MM HAZ-2: Vessel fueling restrictions.	Vessel fueling shall only occur at an approved docking facility. No cross vessel fueling shall be allowed.	Reduction in the potential for an accidental spill.	Documentation of fueling activities.	Contract vessel operator.	Following survey.	9/24-28/18 TCE
MM HAZ-3: OSCP equipment and supplies.	Onboard spill response equipment and supplies shall be sufficient to contain and recover the worst-case scenario spill of petroleum products as outlined in the OSCP.	Proper and timely response in the event of a spill.	Notification to CSLC of onboard spill response equipment/supplies inventory, verify	Contract vessel operator.	Prior to survey.	9/24/18 TCE

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
			ability to respond to worst-case spill.			
MM HAZ-1: Oil Spill Contingency Plan (OSCP) Required Information.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-2: Vessel fueling restrictions.	Outlined under **Hazards and Hazardous Materials** (above)					
MM HAZ-3: OSCP equipment and supplies.	Outlined under **Hazards and Hazardous Materials** (above)					
MM BIO-9: Limitations on Survey Operations in Select MPAs.	Outlined under **Biological Resources** (above)					
MM REC-1: U.S. Coast Guard (USCG), Harbormaster, and Dive Shop Operator Notification.	All California waters where recreational diving may occur; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to divers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall: (1) post such notices in the harbormasters' offices of regional harbors; and (2) notify operators of dive shops in coastal locations adjacent to the proposed offshore survey operations.	No adverse effects to recreational divers from survey operations.	Notify the USCG, local harbormasters, and local dive shops of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	9/3/18 TCE

Mitigation Measure (MM)	Location and Scope of Mitigation	Effectiveness Criteria	Monitoring or Reporting Action	Responsible Party	Timing	Implementation Date(s) and Initials
MM FISH-1: U.S. Coast Guard (USCG) and Harbormaster Notification.	All California waters; as a survey permit condition, the CSLC shall require Permittees to provide the USCG with survey details, including information on vessel types, survey locations, times, contact information, and other details of activities that may pose a hazard to mariners and fishers so that USCG can include the information in the Local Notice to Mariners, advising vessels to avoid potential hazards near survey areas. Furthermore, at least twenty-one (21) days in advance of in-water activities, Permittees shall post such notices in the harbormasters' offices of regional harbors.	No adverse effects to commercial fishing gear in place.	Notify the USCG and local harbormasters of planned survey activity. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Prior to survey.	9/3/18 TCE
MM FISH-2: Minimize Interaction with Fishing Gear.	To minimize interaction with fishing gear that may be present within a survey area: (1) the geophysical vessel (or designated vessel) shall traverse the proposed survey corridor prior to commencing survey operations to note and record the presence, type, and location of deployed fishing gear (i.e., buoys); (2) no survey lines within 30 m (100 feet) of observed fishing gear shall be conducted. The survey crew shall not remove or relocate any fishing gear; removal or relocation shall only be accomplished by the owner of the gear upon notification by the survey operator of the potential conflict.	No adverse effects to commercial fishing gear in place.	Visually observe the survey area for commercial fishing gear. Notify the gear owner and request relocation of gear outside survey area. Submit Final Monitoring Report after completion of survey activities.	OGPP permit holder.	Imme-diately prior to survey (prior to each survey day).	9/24/18 TCE
MM FISH-1: USCG and Harbormaster Notification.	Outlined under **Commercial and Recreational Fisheries** (above)					

Acronyms/Abbreviations: CARB = California Air Resources Board; CDFW = California Department of Fish and Wildlife; CSLC = California State Lands Commission; dB = decibels; kHz = kilohertz; MPA = Marine Protected Area; MWCP = Marine Wildlife Contingency Plan; MWM = Marine Wildlife Monitor; m= meter(s); NOAA = National Oceanic and Atmospheric Administration; NO_x = Nitrogen Oxide; OGPP = Offshore Geophysical Permit Program; OSCP = Oil Spill Contingency Plan; USCG = U.S. Coast Guard